REMARKS

Claims 1-17 were pending in the present application. Claims 1, 3, 5, 6, 8, 10 and 11 have been amended. Claims 14-17 have been cancelled without prejudice to or disclaimer of the subject matter contained therein in view of the finality of the Restriction Requirement. Applicants reserve the right to file a divisional application on the cancelled subject matter. Claims 1-13 are presently pending.

Reexamination of the application and reconsideration of the rejections are respectfully requested in view of the above amendments and the following remarks, which follow the order set forth in the Office Action.

Rejection under 35 U.S.C. §112, second paragraph, is moot

Claims 6-13 were rejected under 35 U.S.C. §112, second paragraph, as to the phrase "insertion-type," which is recited in claims 6, 8 and 10. The phrase has been replaced by the term "insertion" rendering the rejection moot.

Rejection under 35 U.S.C. §103 over Goodenough is traversed

Claims 1, 3 and 6-13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Goodenough et al. (U.S. Patent No. 5,910,382; hereinafter referred to as "Goodenough"). Applicants respectfully traverse the rejection, specifically for process claims 1 and 3, composition claims 6-7 and product-by-process claims 8-13, as separately discussed below, for the following reasons.

Claims 1 and 3

Presently amended claim 1 of the instant application recites a process for the manufacture of a $LiMPO_4$ powder. The process comprises the steps of:

providing an equimolar aqueous solution of Li^{1+}, M^{n+}, and PO_4^{3-} prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and which, upon heating at a temperature below 500° C, decompose to form a pure homogeneous Li and M phosphate precursor;

evaporating water from the solution, thereby producing a solid mixture;

decomposing the solid mixture at a temperature below 500° C to form a pure homogeneous Li and M phosphate precursor; and

annealing the precursor at a temperature of less than 800° C in an inert or reducing atmosphere, thereby forming a $LiMPO_4$ powder of olivine structure.

M^{n+} is one or more of Fe^{2+}, Fe^{3+}, Co^{2+}, Ni^{2+}, and Mn^{2+}, and M is $Fe_x,Co_yNi_zMn_w$,with $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq w \leq 1$, and $x + y + z + w = 1$. Currently amended claim 3 of the instant application recites a process for the manufacture of a $LiFePO_4$ powder from a process analogous to that of claim 1.

Goodenough discloses transition metal compounds having the ordered olivine or rhombohedral NASICON structure. *Goodenough Abstract.* In one aspect, Goodenough discloses rhombohedral NASICON materials having the formula $Y_xM_2(PO_4)_3$, where $0<x<5$. *Goodenough, col. 2, lines 40-46.* Goodenough discloses that the rhombohedral NASICON compounds "may typically be prepared by preparing an aqueous solution comprising a lithium compound, an iron compound, a phosphate compound and a sulfate compound, evaporating the solution to obtain dry material and heating the dry material to about 500 °C." *Goodenough, col. 3 line 63 to col. 4 line 2.*

Goodenough also discloses ordered orthorhombic olivine compounds having the general formula $LiMPO_4$, where M is at least one first row transition-metal cation. Goodenough discloses a solid state process for preparing $LiMPO_4$ material of olivine structure. *Goodenough, Example 1, col. 11, lines 50-57.* Goodenough is silent as to a process of preparing $LiMPO_4$ powder of olivine structure using an equimolar aqueous solution of Li^{1+}, M^{n+}, and PO_4^{3-}.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *MPEP §2143.*

The Action states: "Goodenough suggests the instantly claimed process of making $LiMPO_4$ powder by evaporating an aqueous solution of a lithium compound, an iron compound and a phosphate compound and then heating to about 500°C . . . ." *Office Action mailed 12/20/06; page 4.* Applicants respectfully disagree with this reading of Goodenough. The disclosed aqueous process of Goodenough is directed only to *rhombohedral* NASICON materials having the formula $Y_xM_2(PO_4)_3$, where $0<x<5$. Currently amended claims 1 and 3 recite a $LiMPO_4$ material of the olivine structure, which is *orthorhombic*, made by an

aqueous process. Both the chemical composition and structure of the material prepared by an aqueous process as disclosed in Goodenough are different from what is recited in the instant claims (M_2 vs M and NASICON vs olivine, respectively). While Goodenough discloses olivine structured material, that material is described as prepared by solid-state processes. For example, see Example 1 of Goodenough, which states that $LiFePO_4$, was prepared by mixing proportions of Li, Fe and PO_4 and calcining. "Similar solid-state reactions were used to prepare $LiMnPO_4$, $LiFe_{1-x}Mn_xPO_4$, $LiCoPO_4$ and $LiNiPO_4$." *Goodenough, Example 1; col. 11, lines 50-57.* No aqueous process is taught or suggested for olivine structured $LiMPO_4$ material in Goodenough. Thus, the patent fails to teach or suggest all the elements of claims 1 and 3. Nor is there any teaching or suggestion in Goodenough to modify the aqueous process of forming material of NASICON structure to an aqueous process for forming a $LiMPO_4$ material of olivine structure. In view thereof, a *prima facie* case of obviousness has not been made. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 6 and 7

Claims 6 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over Goodenough. In the Action, these composition claims are collectively rejected with the process claims and product-by-product claims. As such, the grounds for rejection of claims 6 and 7, as stated in the Action, appear inconsistent with their statutory class. Nonetheless, Applicants respectfully traverse the rejection for the following reasons.

Amended claim 6 recites a powder for use in lithium insertion electrodes with a formula $LiMPO_4$ having an average particle size of less than 1 μm, wherein M is $Fe_xCo_yNi_zMn_w$, with $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq w \leq 1$, $x + z + w > 0$, and $x + y + z + w = 1$. Claim 7 further requires that M is Fe, and that the powder have a reversible electrode capacity of at least 65% of a theoretical capacity when used as an active component in a cathode that is cycled between 2.70 and 4.15 V vs. Li^+/Li at a discharge rate of C/5 at 25° C.

Goodenough is silent as to an average particle size of olivine structured $LiMPO_4$ materials. Applicants' specification discloses a synthesis technique based on the use of components that may be dissolved in water to yield, after decomposition and annealing under inert or reducing atmosphere, a $LiMPO_4$ powder of olivine structure having an average particle size of less than 1 μm. (*Applicants' specification, page 6, lines 12-14*). In the specification, the effect of $LiMPO_4$ particle size on the functionality of the powder as an electrode material is elaborated by way of a direct comparison of a solid state processed

olivine material of $LiMPO_4$ and Applicants' $LiMPO_4$ material from an aqueous process. *See Applicants specification, page 6, lines 7-10; page 7, line 25 through page 8, line 23; including Figures 2, 6A, 6B and 7.* The comparison demonstrates that $LiMPO_4$ particle size of material formed from a solid state process is of the order of 50 μm or larger. *Applicants' specification, page 6, lines 7-10 and FIG. 2.* The solid-state formed powder achieves less than 40% of its theoretical capacity compared to 80% of theoretical capacity for Applicants' powder formed from an aqueous process. *Id.* Moreover, grinding of solid-state formed $LiMPO_4$ powder to a smaller average particle size does not remedy the deficit of the theoretical capacity but actually reduces its capacity from 40% to 15%. *Applicants' specification, page 8, lines 7-11 and FIG. 6B.*

It would not have been obvious to one skilled in the art to modify the teachings of Goodenough to arrive at the $LiMPO_4$ powder as recited in claim 6 because Goodenough is silent as to any $LiMPO_4$ particle size. No suggestion or motivation exists in Goodenough in view of the absence of a recitation of average particle size. Nor would there be any likelihood of success to modify Goodenough to achieve a powder of average particle size of less than 1 μm because, as disclosed in Applicants' specification, milling the solid-state $LiMPO_4$ material does not increase theoretical capacity but instead decreases its capacity. Thus, the $LiMPO_4$ material prepared by the solid-state process of Goodenough is not functionally or structurally equivalent to the $LiMPO_4$ material as claimed. The data disclosed in Applicant's specification, therefore, supports unexpected results of Applicants' $LiMPO_4$ material of less than 1 μm average particle size over the cited solid state process of preparing $LiMPO_4$ material in Goodenough.

As a result of Goodenough being silent as to an average particle size, being unable to produce an average particle size of 1 μm by solid state processing and the unexpected results observed for $LiMPO_4$ having an average particle size of less than 1 μm, Applicants' composition, as recited in claims 6-7, is non-obvious over the cited art. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 8-13

Currently amended claim 8 recites a powder for use in lithium insertion electrodes. The powder is prepared by a process comprising the steps of:

providing an equimolar aqueous solution of Li^{1+}, M^{n+}, and PO_4^{3-} prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and

which, upon heating at a temperature below 500° C, decompose to form a pure homogeneous Li and M phosphate precursor;

evaporating water from the solution, therey producing a solid mixture;

decomposing the solid mixture at a temperature below 500° C to form a pure homogeneous Li and M phosphate precursor; and

annealing the precursor at a temperature of less than 600° C in an inert or reducing atmosphere, thereby forming a $LiMPO_4$ powder of olivine structure and having an average particle size of less than 1 μm;

wherein M^{n+} is one or more of Fe^{2+}, Fe^{3+}, Co^{2+}, Ni^{2+}, and Mn^{2+}, and M is $Fe_xCo_yNi_zMn_w$, with $0 \leq x \leq 1$, $0 \leq y \leq I$, $0 \leq z \leq I$, $0 \leq w \leq 1$, and $x + y + z + w = 1$.

Currently amended claim 10 recites a battery comprising a lithium insertion electrode including a powder prepared by a process analogous to that of claim 8.

The Action states that "[a]ny difference imparted by the product by process limitations would have been obvious to one having ordinary skill in the art at the time the invention was made because [where] the examiner has found a substantially similar product [as] in the applied prior art." *Office Action mailed 12/20/06, page 4.*

The above analysis is presumably based on MPEP §2113, which states: "even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citations omitted); MPEP §2113.*

As pointed out above, Goodenough is silent as to a $LiMPO_4$ powder of olivine structure having an average particle size of less than 1 μm as recited in claims 8-13. Goodenough's powder is not substantially the same, both structurally (size of particles) and functionally (capacity) to that the $LiMPO_4$ powder as claimed.

Applicants, therefore, have satisfied the burden of proof in establishing that their $LiMPO_4$ powder is patentably distinct from the $LiMPO_4$ powder of Goodenough because Applicants' product is a powder that is of an olivine structure having an average particle size of less than 1 μm. Goodenough fails to teach or suggest all the claim limitations of the $LiMPO_4$ powder as recited in independent claims 8 and 10. Therefore, the requisite *prima facie* case of obviousness cannot be made.

Since a *prima facie* case of obviousness has not been made against independent claim 8, dependent claim 9 would not have been obvious from the art cited. Likewise, since a *prima facie* case of obviousness has not been made against independent claim 10, dependent claims 11-13 would not have been obvious from the art cited. In view thereof, Applicants respectfully request that this rejection be withdrawn.

Rejection under 35 U.S.C. §103 over Goodenough in view of Yamada is traversed

Claims 2 and 4 were rejected under 35 U.S.C. §103(a) as being unpatentable over Goodenough and further in view of Yamada, et al. (*J. Electro. Chem. Soc.* (2001) 148: A224-29; hereinafter referred to as "Yamada"). Applicants respectfully traverse the rejection for the following reasons.

Original claims 2 and 4 require the step of annealing the precursor, where the annealing temperature is less than 600° C in the process according to claims 1 and 3, respectively.

As described above, Goodenough is silent as to an aqueous process providing a $LiMPO_4$ powder of olivine structure. In the Action, it is stated that Goodenough teaches an annealing temperature of 800° C. *Office Action mailed 12/20/06, page 5.*

Yamada discloses $LiMPO_4$ powders prepared using a "solid-state" process. (*Yamada, Experimental Section; p. A225; first sentence*). Yamada is silent as to an aqueous process of providing $LiMPO_4$ powder of olivine structure. Yamada discloses dispersing a mixture of $Fe(CH_3CO_2)$, $NH_4H_2PO_4$, and $LiCO_3$ in acetone with mixing and grinding, followed by evaporation of the acetone, decomposition at 320 °C and sintering at a temperature ranging from 400 to 800° C. Yamada is silent as to aqueous solutions of Li^{1+}, M^{n+}, and PO_4^{3-}.

In the Action it is stated that "[i]t would have been obvious to one skilled in the art to heat or anneal the material in Goodenough at 500-600° C because this temperature range maximizes capacity." *Office Action mailed 12/20/06; page 5.* Applicants respectfully traverse this rejection.

As stated above, Goodenough fails to teach or suggest all the limitations of the process claims 1 or 3, from which claims 2 and 4 depend therefrom, respectively. Yamada, alone or in combination with Goodenough, fails to rectify this deficit. The references, alone or in combination, fail to teach or suggest all the limitations of the claims. Motivation or likelihood of success in the combination of references to allegedly to "maximize capacity" is lacking because of the absence of the all of the claimed elements in the combination of

references. Therefore, a *prima facie* case of obviousness cannot be made. Thus, reconsideration and withdrawal of the rejection is respectfully requested.

For the foregoing reasons, claims 1-13 are considered allowable. A Notice to this effect is respectfully requested. If any questions remain, the Examiner is invited to contact the undersigned at the number given below.

Respectfully submitted,

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